November 30, 2005

Mr. James M. Levine
Executive Vice President, Generation
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Arizona Public Service Company
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SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 - RESPONSE TO NRC BULLETIN 2003-01, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS" (TAC NOS. MB9596, MB9597, AND MB9598)

Dear Mr. Levine:

This letter acknowledges receipt of your response dated August 8, 2003, to Nuclear Regulatory Commission (NRC) Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," dated June 9, 2003. The NRC issued Bulletin 2003-01 to all pressurized-water reactor (PWR) licensees requesting that they provide a response, within 60 days of the date of Bulletin 2003-01, that contains either the information requested in following Option 1 or Option 2 stated in Bulletin 2003-01:

Option 1: State that the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions have been analyzed with respect to the potentially adverse post-accident debris blockage effects identified in the Discussion section, and are in compliance with all existing applicable regulatory requirements.

Option 2: Describe any interim compensatory measures (ICMs) that have been implemented or that will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming ECCS and CSS recirculation functions until an evaluation to determine compliance is complete. If any of the ICMs listed in the Discussion section will not be implemented, provide a justification. Additionally, for any planned interim measures that will not be in place prior to your response to this bulletin, submit an implementation schedule and provide the basis for concluding that their implementation is not practical until a later date.

You provided an Option 2 response.

Bulletin 2003-01 discussed six categories of ICMs: (1) operator training on indications of and responses to sump clogging; (2) procedural modifications if appropriate, that would delay the switchover to containment sump recirculation (e.g., shutting down redundant pumps that are not necessary to provide required flows to cool the containment and reactor core, and operating the CSS intermittently); (3) ensuring that alternative water sources are available to refill the refueling water storage tank (RWST) or to otherwise provide inventory to inject into the reactor

core and spray into the containment atmosphere; (4) more aggressive containment cleaning and increased foreign material controls; (5) ensuring containment drainage paths are unblocked; and (6) ensuring sump screens are free of adverse gaps and breaches.

You stated in your August 8, 2003, response that in response to Generic Letter 85-22, "Potential for Loss of Post-LOCA [loss-of-coolant accident] Recirculation Capability Due to Insulation Debris Blockage," Arizona Public Service Company (APS) replaced its original 50% sump screen blockage assumption with a comprehensive mechanistic assessment of debris blockage of the ECCS sump screens at Palo Verde Nuclear Generating Station (PVNGS). You further stated that the supporting analytical correlations for debris generation and transport were compared to NUREG/CR-6808, “Knowledge Base for the Effects of Debris on PWR Emergency Core Cooling Sump Performance,” verifying that the generation and transport results of the design basis analysis remained valid, and that the associated risk of degraded ECCS performance was low. You concluded that “...only minimal interim compensatory measures have been or will be implemented while additional NRC research continues and a more detailed and comprehensive evaluation methodology is developed.”

You further stated in your August 8, 2003, response that the PVNGS as-built design minimizes the total fibrous debris loading. You provided an extensive discussion of the loose fibrous material insulation (Fiberfax) which is installed in the annulus of the pipe penetrations through the biological shield wall. You concluded that conservatisms contained in the current analyses, and your considerations of debris source location and other factors, substantiate that the quantities of the fibrous materials at the sump screen will be a small fraction of that documented in PVNGS analyses.

You also stated in your August 8, 2003, response that PVNGS has verified that sump screen fine mesh dimensions were limiting to ensure that debris that passed through would be small enough so as to preclude blockage of the containment spray nozzles and the coolant flow paths within the fuel assemblies. You further stated that PVNGS has verifed that debris small enough to pass through the sump screen will be appropriately filtered by the installed cyclone separators on each of the low pressure and high pressure safety injection pumps and the containment spray pumps.

You provided in your August 8, 2003, response sump blockage-related design discussions of the two independent sumps, their sump structure curb, and your large dry containments (specifically in relation to large floor areas conducive to debris settling).

In your August 8, 2003, response, you stated that the following compensatory measures are in place or have been implemented:

(1) a foreign materials exclusion (FME) program, included within an existing housekeeping and system cleanliness procedure, which minimizes potentially transportable materials - ICM category # 4;

(2) a surveillance requirement mandated containment cleanliness inspection program to eliminate loose debris which includes end-of-outage clean-up teams, washdowns of the pump bay floor and walls, sump and pump suction inlet inspections for loose debris, and

evaluations of transient materials left in containment in terms of their potential sump blockage impact - ICM category #4; and

(3) ECCS sump cleaning/inspection procedures which verify that sump components have no evidence of structural distress or corrosion, that there are no gaps in the sump structure or sump structure penetrations without appropriate collars/barriers, that the fine screens are adequately tack welded in place and secured against hydrodynamic loads - ICM category #6.

In your response to Bulletin 2003-01, you stated that the following ICMs have been or will be taken:

(1) containment walkdowns recommended by the Nuclear Energy Institute (NEI) 02-01 (a document generated by NEI) - ICM category #4;

(2) new administrative requirements for the review of all plant changes which may affect debris generation, transport and sump screen accumulation (by September 30, 2003) - ICM category #3;

(3) an engineering review to assess the potential for debris accumulation (and therefore ECCS flow restriction) on the pump bay personnel access doors, to have been completed by November 30, 2003, with any resultant plant changes to be implemented prior to startup during the subsequent refueling outage for each unit - ICM category #5; and

(4) new licensed operator required reading of Bulletin 2003-01, and excerpts from the APS response relating to the potential for degraded ECCS and CSS pump performance due to accumulated debris on the containment sump screens - ICM category #1.

In your response to Bulletin 2003-01, you further stated that APS plans to defer implementation of the following ICMs until they are put forth in CEN-152 (Combustion Engineering Emergency Procedure Guideines or EPGs) changes by the Westinghouse Owners Group (WOG):

(1) specific training on the identification of and response to sump clogging;

(2) changes to the PVNGS Emergency Operating Plans (EOPs) that delay the switchover to containment sump recirculation;

(3) procedural changes to delay refueling water tank (RWT) inventory (you noted that the PVNGS RWT inventory during normal operations is substantially greater than the minimum requirements assumed for ECCS performance, but less than the maximum LOCA containment water volume for safety-related equipment submergence);

(4) procedural changes to refill the RWT; and

(5) EOP changes to inject alternative water sources into the reactor coolant system (RCS);

In an October 22, 2004, response to a September 1, 2004, NRC request for additional information (RAI) you discussed plant changes needed to address the potential for debris

accumulation on the pump bay personnel access doors. You stated that:

(1) the plant modification being implemented is a physical restraint to hold the doors open during Modes 1, 2, 3, and 4 (except when being utilized as a locked high radiation barrier in Modes 3 and 4 for Technical Specification compliance); and

(2) APS had initiated a review of the generic operational guidance from the WOG issued in WCAP-16204, "Evaluation of Potential ERG [Emergency Response Guidelines] and EPG Changes to Address NRC Bulletin 2003-01 Recommendations, Revision 1," dated March 2004. Final review and recommendations of the WOG candidate operator actions (COAs - ICMs) was to be completed by February 25, 2005, with a schedule for implementation submitted to the NRC by March 25, 2005.

In a letter dated January 22, 2004, you provided supplemental information relating to your Bulletin 2003-01 response. You stated that on December 2, 2003, during a routine PVNGS Unit 2 outage inspection, a one-inch diameter hole was discovered in the top cover plate on each of the two containment sump screen structures (larger than the screen mesh size of 0.09"). The holes were plugged and subsequent inspections in Unit 1 and Unit 3 revealed no similar holes in the sump cover plates. You noted that the Unit 2 holes had resulted from a design change package which relocated a fluid temperature detector conduit during initial plant construction in 1985.

In a letter dated March 25, 2005, you submitted your conclusions regarding the WOG COAs for PVNGS, and a schedule for implementation of those selected COAs determined to reduce risk associated with sump screen blockage, stating that for:

(1) COA 1a, "Operator Action to Secure One Spray Pump," this COA would not be implemented because your non-fan cooler containment design precluded adequate heat removal should the remaining operating spray pump fail after securing one spray pump manually;

(2) COA 1b, "Operator Action to Secure Both Spray Pumps," this COA would not be implemented because your non-fan cooler design precluded adequate heat removal;

(3) COA 2, "Manually Establish One Train of Containment Sump Recirculation Prior to Automatic Actuation," you concluded that, since implementation of this operator action is recommended only for plants which have the ability to secure one or both spray pumps, PVNGS would not implement this COA (see COA 1a and COA 1b discussions above);

(4) COA 3, "Terminate One Train of HPSI [High-Pressure Safety Injection]/High-head Injection After Recirculation Alignment," you concluded that, given that the risk of sump blockage at PVNGS is low (see discussions of debris loading, Fiberfax, analytical conservatisms, debris source loadings, sump screen dimensions, and debris transport results above), this measure would result in a net increase in plant risk and would not be implemented;

(5) COA 4, "Early Termination of One LPSI[Low-Pressure Safety Injection]/RHR [Residual Heat Removal] Pump Prior To Recirculation Alignment," you concluded that, given that the risk of sump blockage at PVNGS is low (see discussions of debris loading, Fiberfax,

analytical conservatisms, debris source loadings, sump screen dimensions, and debris transport results above), this measure would result in a net increase in plant risk;

(6) COA 5, “Refill of Refueling Water Storage Tank,” you concluded that PVNGS would implement this COA and that, since this measure requires considerable change to the current event mitigation strategy, extensive training will be needed and the scheduled completion date, considering the various operator training cycles, would be February 24, 2006 - ICM category #3;

(7) COA 6, “Inject More Than One RWST Volume From a Refilled RWST or By Bypassing the RWST,” you concluded that this action is for a beyond design basis situation and would, therefore, be coordinated by the Technical Support Center (TSC) in accordance with the Severe Accident Management Guidelines (SAMGs) - ICM category #3;

(8) COA 7, “Provide More Aggressive Cooldown and Depressurization Following a Small Break LOCA,” you concluded that APS would make the procedure changes and complete the associated operator training by February 24, 2006 - ICM category #2;

(9) COA 8, “Provide Guidance on Symptoms and Identification of Containment Sump Blockage,” you concluded that APS would implement procedure changes and associated operator training by February 24, 2006 - ICM category #1;

(10) COA 9, “Develop Contingency Actions in Response to: Containment Sump Blockage, Loss of Suction, and Cavitation,” you concluded that APS would implement this COA as an outgrowth of its implementation of COAs 5, 7, and 8 discussed above, with completion by February 24, 2006 - ICM category #1.

(11) COA 10, “Early Termination of One Train of HPSI/High Head Injection Prior to Recirculation Alignment,” you concluded that, given that the risk of sump blockage at PVNGS is low (see discussions of debris loading, Fiberfax, analytical conservatisms, debris source loadings, sump screen dimensions, and debris transport results above), this measure would result in a net increase in plant risk;

(12) COA 11, “Prevent or Delay Containment Spray for Small Break LOCAs (<1 Inch Diameter) in Ice Condenser Plants,” you concluded that, since PVNGS does not use ice condensers, this COA was not applicable at PVNGS with its dry containment design.

In an August 30, 2005, letter, in response to June 22 and August 3, 2005, NRC RAIs regarding the WOG COAs, you elaborated on why you believe the risk of sump blockage is low, and stated that for:

(1) COA 3, “Terminate One Train of HPSI/High-head Injection After Recirculation Alignment,” the risk from operator errors and mechanical and electrical failures for safety injection train restart upon remaining train single failure (from operator error, equipment failure, or sump clogging) outweigh the risk from both safety injection trains failing from sump clogging;

(2) COA 4, “Early Termination of One LPSI/RHR Pump Prior To Recirculation Alignment,” the risk from operator errors and mechanical and electrical failures for safety injection

train restart upon remaining train single failure (from operator error, equipment failure, or sump clogging) outweigh the risk from both safety injection trains failing from sump clogging;

(3) COA 5, “Refill of Refueling Water Storage Tank,” the RWT refill operation would begin upon switchover to sump recirculation - ICM category #3;

(4) COA 6, “Inject More Than One RWST Volume From a Refilled RWST or By Bypassing the RWST,” the SAMG procedures would direct, based on maintaining fission product barrier integrity by keeping the core covered, the injection of refilled RWT inventory via charging pumps and the normal or alternate charging lines, or via a HPSI or LPSI pump and the hot/cold leg injection lines, and potential alternate (RWT bypass) injection sources would be the spent fuel pool, the reactor makeup water tank, the recycle monitor tanks, the volume control tank, the holdup tank, the total dissolved solids tanks, the condensate storage tanks, and the demineralized water storage tank - ICM category #3;

(5) COA 7, “Provide More Aggressive Cooldown and Depressurization Following a Small Break LOCA,” the definitional differences between a “controlled cooldown” and a “rapid cooldown” are being clarified so that operators understand that, if the LOCA break source can not be isolated, a controlled cooldown is performed at or as close to the Technical Specifications limit as can be achieved for the current plant conditions (maximum allowed cooldown rate) - ICM category #2;

(6) COA 8, “Provide Guidance on Symptoms and Identification of Containment Sump Blockage,” operators are to be provided with a list of three loss of pump suction indications, a list of eight specific parameters to monitor as indications of sump blockage, direction to baseline and trend indications, possible causes of large or sudden changes in indications, and a discussion of sump head loss severities versus their expected indications - ICM category #1;

(7) COA 9, “Develop Contingency Actions in Response to: Containment Sump Blockage, Loss of Suction, and Cavitation,” upon sump blockage, the operators may transition from Safety Function Status Checks and the LOCA Optimal Recovery Guideline to the Functional Recovery Guideline for safety function restoration, consult with the TSC, and may transition to the SAMGs for core cooling and RCS inventory control restorative actions. In additon, PVNGS will review the Westinghouse Sump Blockage Control Room Guideline to see if additional information should be provided to its operators for dealing with sump blockage events - ICM category #1; and

(8) COA 10, “Early Termination of One Train of HPSI/High Head Injection Prior to Recirculation Alignment,” the risk from operator errors and mechanical and electrical failures for safety injection train restart upon remaining train single failure (from operator error, equipment failure, or sump clogging) outweigh the risk from both safety injection trains failing from sump clogging.

The NRC staff has considered your Option 2 response for compensatory measures that were or were to have been implemented to reduce the interim risk associated with potentially degraded or nonconforming ECCS and CSS recirculation functions. Based on your response, the NRC staff considers your actions to be responsive to and meet the intent of Bulletin 2003-01. Please

retain any records of your actions in response to Bulletin 2003-01, as the NRC staff may conduct subsequent inspection activities regarding this issue.

Should you have any questions, please contact me at 301-415-3062 or the lead PM for this issue, Alan Wang at 301-415-1445.

Sincerely,

/RA/

Mel B. Fields, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-528, STN 50-529,
and STN 50-530

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Mel B. Fields, Senior Project Manager
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